U.S Integrated Earth Observation System

Improved Observations for Disaster Warnings

Preamble

The USGEO is coordinating the activities to formulate integration framework documents for the six near-term opportunity areas identified in the Strategic Plan for the U.S. Integrated Earth Observation System.

One of the steps is to take inventory of the Earth observation systems, models, and decision support systems that exist or are planned to be developed over the coming years. The following tables are initial compilations of U.S. capabilities in Earth observation systems, models and decision support systems. Earth observation systems, models, and decision support systems identified in the tables are candidates for inclusion in Integrated Earth Observation System configurations for each of the near term opportunity areas.

These tables are draft and as such, are neither exclusive nor comprehensive. We invite interested members of the community to provide input to the content of these tables and system configurations – both during the sessions on the second day of the IEOS Public Engagement Workshop and through email submissions to the USGEO. Your review and input to these tables and to the Integrated Earth Observation System configurations for each of the near term opportunities is greatly valued and appreciated.

Draft Table 1. Products, Services, Observing Systems and Models

Products/Services	Observing System/Model	Instrument/Parameter	Agency
Deformation (3-D) of Earth's surface-all physical scales and time scales	Repeat-pass airborne InSAR	Monitor deformation using InSAR	NASA-Airborne
Detect/characterize local thermal features-all timescales	TIMS[1]	IR imagery of active volcanic features-various scales	
Topography and digital elevation models-all scales	SRTM and other stereo imagery	Local to regional scale DEMs	NASA/USGS Spaceborne
Land utilization	EO-1	ALI[2]	
Land cover	Terra	MODIS[3]	NASA-Spaceborne

[1] http://www.nasa.gov/centers/dryden/research/AirSci/ER-2/tims.html
[2] http://eo1.gsfc.nasa.gov/new/baseline/techVal/instrumentTech.html

Products/Services	Observing System/Model	Instrument/Parameter	Agency
classification			
Detect and monitor high-level ash clouds, acid and other volcanic aerosols			
Land surface temperature		ASTER[4]	
Characterize gas emissions by species and flux			
Precipitation	Rain gauge networks Doppler radars	Precipitation leads to increased risk of landslides, secondary lahars, liquefaction	NOAA - Surface
Atmospheric moisture profile	Ground based radar LIDAR	Needed to correct for effect of H2O in volcanic ash cloud	
Shallow water bathymetry	Ship surveys with multibeam sonar	Seafloor configuration details	
Waves (heights, patterns)	Buoys Coastal radar	Document, monitor near-shore effects of tsunamis	
Tsunami detection	DART buoys	Pressure changes detect passage of tsunami	
Volcanic plume dispersion		HYSPLIT PUFF	NOAA-Model Note: PUFF is not a NOAA model
Shallow water bathymetry		Tsunami run up models	
Atmospheric moisture profile	Radiosondes	Needed to correct for effect of H2O in volcanic ash cloud	NOAA-Airborne
Wind velocity and direction, vertical wind profile			
Shallow water bathymetry	Bathymetric LIDAR		
Characterize regional thermal emissions, flux-all time scales	GOES	Imager/Sounder[5]	NOAA-Spaceborne
Characterize regional thermal emissions, flux-all time scales	POES/NPOESS	AVHRR[6]	Note: DMSP is operated by DoD, not NOAA.
Detect and monitor high-level ash clouds, acid and other	DMSP POES, GOES		

[3] http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=3
http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=3
[4] http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=72
[5]http://www.asd.ssc.nasa.gov/m2m/related_products.aspx?id=245&section=links&sub_geophys_id=&model_id=245&page=mission
[6] http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=74

Products/Services	Observing System/Model	Instrument/Parameter	Agency
volcanic aerosols			
Thermal sensing	GOES	Thermal anomalies, features at volcanoes[7]	
Geologic maps-all scales	Field surveys, laboratory analyses	Bedrock geology, structural geology, surficial geology with ages of units	USGS-Surface
Gravity surveys	Gravimeter surveys	Gravity changes resulting from magma intrusion, tectonic activity	
Detect/characterize local thermal features-all time scales	Field instruments (pyrometers, thermocouples)	Temperatures of hot springs, fumaroles, volcanic fissures, lava flows, etc.	
	IR cameras		
Characterize gas emissions by species and flux	COSPEC (ground or vehicle mounted)	Monitor SO2 and CO2 at volcanoes	
	LICOR (ground or vehicle mounted)		
	OPFTIR (ground or vehicle mounted)		
Ground water levels and pore pressure	Piezometers	Water levels, pore pressure affect extent of landslides, liquefaction; monitor geothermal activity	
	Tensiometers		
	Well monitors		
Soil moisture	Piezometers	Affects soil response to ground shaking	
	Tensiometers		
Seismicity	ANSS	Network of seismometers(i.e. modern 3-component, high dynamic range broadband seismometers)	USGS -Surface NOAA Pacific Tsunami Warning Center-Surface
	GSN	Network of seismometers(i.e. modern 3-component, high dynamic range broadband seismometers)	
	Volcano seismic networks	Network of seismometers(i.e. modern 3-component, high dynamic range broadband seismometers)	Note: These observables should not be lumped with seismicity. They are different.
Stream flow: stage, discharge and volume	Stream gages	Affects landslide behavior, coastal flooding patterns	
Tides, coastal water	Tide and river gages	Influence on severity of	

[7] http://www.asd.ssc.nasa.gov/m2m/mission_report.aspx?mission_id=1844

Products/Services	Observing System/Model	Instrument/Parameter	Agency
levels		tsunamis	
Strain and creep monitoring	Creep meters	Monitor slow, local deformation associated with faults, landslides and volcanoes, or of critical structures	USGS/NIST-Surface
	Dilatometers		
	Tensor strain meters including borehole strainmeters		
Strong motion characterization	Accelerometers	Response of structures to seismic shaking	USGS/NIST/FEMA-Surface
	Strain meters		
Deformation (3-D) of Earth's surface-all physical scales and time scales	SCIGN	Continuous and campaign GPS to monitor deformation at different time scales	USGS/NSF/NASA-Surface
	PBO		
	Tilt and EDM monitoring networks at volcanoes		
Deformation (3-D) of Earth's surface-all physical scales and time scales	Deformation models		USGS/NSF/NASA-Model
	Depth-of-source models		
Seismicity		Models for earthquake location, magnitude and source	USGS Model
		Aftershock occurrence models	
		National seismic hazard maps	
Strong motion characterization		ShakeMaps	USGS/NIST/FEMA/State and local-Model
		PAGER	
		HAZUS	
Topography and digital elevation models- all scales	LIDAR, stereo photography, airborne SAR	High-resolution local DEMs especially for landslides, coastal areas	USGS/NASA-Airborne
Inundation area	Aerial photography, LIDAR, airborne SAR	Document and track inundation patterns	USGS/NOAA/FEMA-Airborne
Geologic maps-all scales	Aerial photography	Bedrock geology, structural geology, surficial geology	USGS-Airborne
Detect/characterize local thermal feature-all timescales	MASTER[8]	IR imagery of active volcanic features-various scales	
Characterize gas emissions by species and flux	COSPEC	Monitor SO2 and CO2 at volcanoes	
	LICOR		
Geologic maps-all scales	Landsat 5/7	Panchromatic imager	USGS-Spaceborne
		Multispectral imager	
Geologic maps-all scales	SPOT	Panchromatic imager	
		Multispectral imager	
Detect and monitor high-level ash clouds, acid and other			

[8] http://masterweb.jpl.nasa.gov/

Products/Services	Observing System/Model	Instrument/Parameter	Agency
volcanic aerosols			
Land cover type	Aqua	MODIS[9]	
Atmospheric moisture profile		AMSU[10]	
Direct and monitor high-level ash clouds, acid and other volcanic aerosols	EOS Aura	OMI[11]	
	Nimbus-7	TOMS[12]	
	Meteor-3		
Waves (heights, patterns)	Jason-1	Radar altimeter[13]	
Soil moisture	HYDROS	3-km resolution soil moisture[14]	
Deformation (3-D) of Earth's surface-all physical scales and time scales	GPS satellites[15]	Highly accurate, three-dimensional location information, accurate velocity and time determination	DoD-Spaceborne
			Any other Contributing Agency -Surface
			Any other Contributing Agency-Model
			Any other Contributing Agency-Spaceborne
Earth surface data	Radarsat 1/2[16]	Synthetic Aperture Radar	CSA/Radarsat International
Earth surface data	Envisat[17]	ASAR	ESA
Earth surface data	ERS-2[18]	SAR, Radar	
Earth surface data	ALOS PALSAR[19] still to be launched!	L-Band Synthetic Aperture Radar	JAXA
1 meter b&w, 4-meter multispectral, 1-meter color, and 1 and 4-meter data bundle	Ikonos[20]	11 bit panchromatic-11 bit multispectral	Space Imaging

Draft Table 2. Decision Support Systems

[9] http://www.asd.ssc.nasa.gov/m2m/sensor_report.aspx?sensor_id=3
[10] http://www.asd.ssc.nasa.gov/m2m/mission_report.aspx?mission_id=222
[11] http://aura.gsfc.nasa.gov/instruments/omi/introduction.html
[12] http://toms.gsfc.nasa.gov/fltmodel/spacecr.html
[13] http://www.asd.ssc.nasa.gov/m2m/mission_report.aspx?mission_id=240
[14] http://www.asd.ssc.nasa.gov/m2m/mission_report.aspx?mission_id=234
[15] http://gps.losangeles.af.mil/jpo/gpsoverview.htm
[16] http://spatialnews.geocomm.com/whitepapers/radarsat1.pdf
[17] http://envisat.esa.int/instruments/tour-index/asar/
[18] http://www.esa.int/esaEO/SEM0V177ESD_index_0.html
[19] http://alos.jaxa.jp/2/palsar-e.html
[20] http://www.spaceimaging.com/products/ikonos/index_2.htm

Decision Support Tool	Description	Contributing Agencies
Hazard zonation or susceptibility maps	For volcanoes, landslides, and probabilistic ground shaking maps	USGS
HAZUS	Ground and structure response to ground shaking	FEMA

Acronym List

A

ACCA	Automatic Cloud Cover Assessment
ADEOS	Advanced Earth Observation Satellite
AGS	Alaska Ground Station
AIRMoN	Atmospheric Integrated Research and Monitoring Network
ALOS	Advanced Land Observing Satellite
AMSR	Advanced Microwave Scanning Radiometer (satellite)
AMSU	Advanced Microwave Sounding Unit (satellite)
ANSS	Advanced National Seismic System
AQI	Air Quality Index
ASAR	Advanced Synthetic Aperture Radar (on Envisat)
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATBD	Algorithm Theoretical Basis Document
AU	Astronomical Unit
AVHRR	Advanced Very High Resolution Radiometer
AVIRIS	Airborne Visible-Infrared Imaging Spectrometer

B

BRDF	Bidirectional Reflectance Distribution Function

C

CCD	Charge Coupled Device
CCSDS	Consultative Committee for Space Data Systems
CCSP	Climate Change Science Plan
CENR	Committee on Environment and Natural Resources
CEOS	Committee on Earth Observation Satellites
CMAQ	Community Multi-scale Air Quality model
COSPEC	Correlation Spectrometer (to detect SO2)
CPF	Calibration Parameter File
CRAM	Combined Radiometric Correction Model

D

DART	Deep-ocean Assessment and Reporting of Tsunami
DEM	Digital Elevation Model
DFCB	Data Format Control Book
DHS	Department of Homeland Security
DIS	Data and Information System’
DMSP	Defense Meteorological Satellite Program
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOQ	Digital Orthophoto Quadrangle
DOT	Department of Transportation
DRM	Data Reference Model

E

ECS	EOSDIS Core System
ECV	Essential Climate Variables
EDM	Electronic Distance Measurement
EOS	Earth Observing System; Earth Observing Subcommittee
EOSAT	Earth Observation Satellite Company
EOSDIS	EOS Data and Information System
EPA	Environmental Protection Agency
EPGS	EOS Polar Ground Sites
EROS	Earth Resources Observation and Science
ERS	European Remote Sensing
ESA	European Space Agency
ET	Evapotranspiration
ETM	Enhanced Thematic Mapper (Landsat instrument)
ETM+	Enhanced Thematic Mapper Plus (Landsat instrument)
EVI	Enhanced Vegetation Index

F

FAC	Full Aperture Calibrator
FDF	Flight Dynamics Facility
FEAF	Federal Enterprise Architecture Framework
FGDC	Federal Geographic Data Committee
FOV	Field of View
FPAR	Fraction of Photosynthetically Active Radiation
FTP	File Transfer Protocol

G

GAW	Global Atmospheric Watch
GCM	General Circulation Model
GCOS	Global Climate Observing System
GEOSS	Global Earth Observation System of Systems
GEOSAT	Geodetic Satellite
GeoTIFF	Geographic Tagged Image File Format
GLOS	Global Land Observation System
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GSD	Ground Sample Distance
GSN	GCOS Surface Network
GTOS	Global Terrestrial Observing System
GUAN	GCOS Upper Air Network

H

HAZUS	Hazards U.S. (FEMA's Hazard and Risk Assessment software package)
HHS	Health and Human Services

I

IAS	Image Assessment System
IEOS	Integrated Earth Observation System
IFOV	Instantaneous Field of View
IGBP	International Geosphere-Biosphere Programme
IGCO	Integrated Global Carbon Observation
IGOS	Integrated Global Observation System
IGS	International Ground Stations
InSAR	Interferometric Synthetic Aperture Radar
IOC	Initial On-orbit Checkout
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
IWGEO	Interagency Working Group on Earth Observations

J

JPL	Jet Propulsion Laboratory

L

LAHARZ	Lahar Zonation (lahar run-out model)
LAI	Leaf Area Index
LGS	Landsat Ground Station
LICOR	small infrared analyser for CO2 (brand name)
LIDAR	Light Detection and Ranging
LP DAAC	Land Processes Distributed Active Archive Center
LTAP	Long Term Acquisition Plan
LULCC	Land Use and Land Cover Change

M

MASTER	airborne ASTER sensor
ME	Memory Effect
MEASURE	Mobile Emissions Assessment System for Urban and Regional Evaluation
METEOSAT	Meteorology Satellite
MISR	Multi-angel Imaging Spectroradiometer
MMS	Multi-mission Modular Spacecraft
MOC	Mission Operations Center
MODIS	Moderate Resolution Imaging Spectroradiometer
MRLC	Multi-Resolution Land Characteristics
MSCD	Mirror Scan Correction Data
MSS	Multispectral Scanner
MTF	Modulation Transfer Function

N

NALC	North American Landscape Characterization pathfinder project with land cover
NASA	National Aeronautics and Space Administration
NCEP	National Centers for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
NED	National Elevation Dataset
NEIC	National Earthquake Information Center
NGA	National Geospatial-Intelligence Agency
NHD	National Hydrography Dataset
NIR `	Near Infrared
NISN	NASA Integrated Services Network
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NSF	National Science Foundation
NTO	Near-Term Opportunities
NVEWS	National Volcano Emergency Warning System

O

OMI	Ozone Monitoring Instrument
OP-FTIR	Open-path Fourier Transform Infrared sensor
OSTP	Office of Science and Technology Policy

P

PAC	Partial Solar Calibrator
PAGER	Preliminary Assessment for Global Earthquake Response
PALSAR	Phased Array L-band Synthetic Aperture Radar
PBO	Plate Boundary Observatory (component of Earthscope)
PM	Particulate matter, in sizes less than the number of um stated, e.g., PM2.5
POES	Polar-orbiting Operational Environmental Satellites

Q

QA	Quality Assurance

R

RADM	Regional Acid Deposition Model
RAQMS	Regional Air Quality Modeling System

S

SAR	Synthetic Aperture Radar
SCIGN	Southern California Integrated GPS Network
SCS	Scan Correlated Shift
SGS	Svalbard Ground Station
SLC	Scan Line Corrector
SMA	Scan Mirror Assembly
SME	Scan Mirror Electronics
SMOKE	Sparse Matrix Operator Kernel Emissions Modeling System

SNR	Signal to Noise Ratio
SRR	Solid State Recorder
SRTM	Shuttle Radar Topography Mission
SURFRAD	Surface radiation budget network
SWIR	Short Wave Infrared

T

TDRS	Tracking Data and Relay Satellites
TIMS	Thermal Infrared Multispectral Scanner
TM	Thematic Mapper (Landsat instrument)
TOA	Top-of-Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TRMM/PR	Tropical Rainfall Measuring Mission/Precipitation Radar

U

UAV	Uninhabited Aerial Vehicles
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAF	United State Air Force
USDA	United States Department of Agriculture
USGEO	U.S. Group Earth Observations
USGS	United States Geological Survey

V

VAFTAD	Volcanic Ash Forecast Transport and Dispersion model
VIIRS	Visible Infrared Imager/Radiometer Suite
VNIR	Visible & Near Infrared

W

WFF	Wallops Flight Facility
WGS	World Geodetic System
WMO	World Meteorological Organization
WRS	Worldwide Reference System